IS 6288 (1971): Test Code for Mouldboard Ploughs [FAD 21: Farm Implements and Machinery]

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Indian Standard

TEST CODE FOR MOULDBOARD PLOUGHS

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INDIAN STANDARDS INSTITUTION
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Indian Standard
TEST CODE FOR MOULDBOARD PLOUGHS

0. FOREWORD

0.1 This Indian Standard was adopted by the Indian Standards Institution on 18 October 1971, after the draft finalized by the Farm Implements and Machinery Sectional Committee had been approved by the Agricultural and Food Products Division Council.

0.2 Testing of implements provides to the prospective user an evaluation of their performance, and it helps and guides manufacturers and designers to improve their product or design. This test code is being issued in order to have a uniform pattern of testing of tractor drawn and animal drawn mouldboard ploughs.

0.3 This code has been prepared on the basis of the test procedure being followed in the country specially at the Research Testing and Training Centres and Tractor Training and Testing Station, Budni.

0.4 In reporting the result of a test or analysis made in accordance with this standard, if the final value, observed or calculated, is to be rounded off, it shall be done in accordance with IS : 2-1960*.

1. SCOPE

1.1 This standard prescribes the method of testing mouldboard ploughs in respect of performance of operation and soundness of construction.

2. TERMINOLOGY

2.0 For the purpose of this standard, the following definitions shall apply.

2.1 Soil Inversion — The process through which the furrow slice is inverted during ploughing.

2.2 Soil Pulverization — The process of breaking of soil into smaller aggregates.

2.3 Performance Index — The assessment of the overall performance, at a particular set of soil condition.

*Rules for rounding off numerical values (*revised*).

2.4 Testing Station — Any organization set up or approved by the government for the purpose of testing and releasing the test reports.

3. GENERAL

3.0 The tests recommended below shall be carried out at the testing station both in the laboratory and the field.

3.1 Laboratory Tests — The plough shall be tested in the laboratory:

a) to check the product with the specification sheet submitted by the applicant; and

b) to determine hardness of material and examine constructional details.

3.2 Field Tests — The plough shall be tested in the field to measure and assess the following.

3.2.1 *Shape and Size (Width and Depth) of Furrow*

3.2.2 *Power Requirement (Draft, Speed and Power)*

3.2.3 *Field Efficiency (Effective Field Capacity or Output, Theoretical Field Capacity and Field Efficiency)*

3.2.4 *Soil Inversion*

3.2.5 *Soil Pulverization*

3.2.6 *Performance Index*

3.2.7 *Ease of Adjustment and Maintenance*

3.2.8 *Soundness of Construction*

3.2.9 *Wear in Share*

4. SELECTION OF SAMPLE FOR TEST

4.1 Selection of Sample — The mouldboard plough shall be taken from the series production by the authorities of the testing station with the agreement of the applicant. The plough shall be a production model in all respects. The applicant may submit prototype for confidential tests.

4.2 Specification Sheet — The applicant shall furnish the specification in accordance with Appendix A.

4.3 Assembling and Preliminary Adjustments — It would be the responsibility of the applicant to ascertain that plough selected for testing is complete in all respects and necessary adjustments have been carried out in the presence of the representative of the testing station.

5. LABORATORY TESTS

5.1 The specification given by the applicant shall be checked and recorded in Appendix A.

5.2 The plough should be dismantled and the material of construction, and hardness shall be tested. The data shall be recorded as in Appendix B. The hardness of steel parts should be tested in accordance with IS : 1500-1968* and in case of cast iron parts in accordance with IS : 1789-1961†.

6. PREPARATION OF SAMPLE FOR FIELD TESTS AND SELECTION OF LAND

6.1 Preparation of Sample

6.1.1 Testing authority shall ensure that the plough has been properly assembled after laboratory test.

6.1.2 All the attachments and accessories should be fitted in proper place and the adjustments made therein shall be in accordance with the applicant's setting and adjustments (*see* **4.3**).

6.1.3 The plough should be properly hitched with source of power. As far as possible the same model, make and hp range of tractor should be employed for testing as specified by the applicant.

6.2 Selection of Land

6.2.1 The minimum area of the plot for testing animal drawn plough should be 0·25 hectare and for tractor drawn plough one hectare. The ratio of width and length of the plot should be, as far as possible, 1 : 2.

6.2.2 The following field conditions of the plot shall be checked and reported:

a) Site of the plot;
b) Type of soil;
c) Last crop grown;
d) Date of last crop harvested;
e) Date and details of preceding tillage treatments, if any, after the date of harvesting of last crop;
f) Topography of the field;
g) Soil moisture percentage (*see also* **7.0**); and
h) Bulk density (*see also* **7.0**).

*Method for Brinell hardness test for steel (*first revision*).

†Method for Brinell hardness test for grey cast iron.

7. FIELD TESTS

7.0 At least three series of field tests shall be carried out under different soil conditions. Under each set of conditions, take at least five samples of soil along with the diagonal lines about 3 m inside the boundary lines. Determine the bulk density and moisture content of the samples and report their average. Depending upon the facilities available, additional series of field tests may be conducted.

7.1 Shape and Size of Furrow

7.1.1 *Shape* — Operate the plough and cover one row length. Clean the furrow carefully and observe the shape of furrow. The shape may be rectangular, triangular or trapezoidal.

7.1.1.1 If the plough is making trapezoidal or triangular furrow its adjustments and hitching should be rechecked and then further tests should be conducted.

7.1.2 *Size of Furrow* — Mark a strip of width (A) on unploughed land from the furrow wall of the furrow already opened (*see* **7.1.1**) for a length of about 30 m. Operate the plough in the marked distance in such a way that a straight row adjacent to furrow wall is cut.

7.1.2.1 *Width* — Measure the marked unploughed land at an interval of about 3 m in length. Take the average of readings obtained, in order to get average width of unploughed strip (B). The difference of A and B would give the width of ploughing if the plough is single bottom; otherwise divide the difference of A and B by the number of plough bottoms in order to get the width of one bottom.

7.1.2.2 *Depth* — Clean carefully the furrow already cut (*see* **7.1.2**) and measure the depth (distance between furrow sole and ground level, measured along the furrow wall) at an interval of about 3 m in length.

7.1.3 Repeat **7.1.1** and **7.1.2** for every test conducted (*see* **7.0**) and record the data as in Appendix C.

7.2 Power Requirement

7.2.1 *For Trailed Tractor Drawn and Animal Drawn Ploughs*

a) Insert a dynamometer in the hitch to measure the draft in kgf. The draft is defined as the horizontal component of the pull, parallel to the line of motion. If the line of pull through the dynamometer is not horizontal, measure the angle, the line of pull makes with the horizontal and calculate the horizontal component (draft) by the following formula:

$$D = P \cos \theta$$

where

D = draft in kgf,

P = pull in kgf, and

θ = angle between line of pull and horizontal.

b) Lay off a space of 30 m in the middle of a long row and mark each end of this space with an easily distinguished pole.

c) Operate the plough as in **7.1.1** above. Start the plough well in advance of the first pole marker and ensure that it is operating uniformly when it reaches this pole. As the plough operates in 30 m space, record the dynamometer reading at about 4 to 5 minutes intervals. Average these readings for obtaining the average draft for the 30 m run. A stop-watch or other accurate time piece should be used to record the time for the plough to traverse the 30 m. From this value the speed of travel in metre per second can be calculated.

d) Calculate the power from the following formula:

$$\text{Metric hp} = \frac{\text{Draft in kgf} \times \text{Speed in metre per second}}{75}$$

e) Repeat the above a minimum of 5 times to arrive at average power requirement. Data should be recorded as in Appendix C.

7.2.2 *For Mounted Tractor Drawn Ploughs*

a) Lay off a space of 30 m in the middle of a long row and mark each end of this space with an easily distinguished pole.

b) A direct reading spring or hydraulic type dynamometer should be attached in front of the tractor. Another tractor should be used to pull the tractor on which the plough is attached.

c) Repeat the operation as in **7.2.1**(c).

d) Detach the plough from the tractor and the draft required only to pull the tractor (with which the plough was attached) should be recorded in same manner as in **7.2.2**(c). Ensure that the tractor is pulled at the same speed as in case of **7.2.1**(c).

e) Draft of the plough may be obtained by deducting the draft of tractor [as obtained in **7.2.2**(d)] from the draft of plough and tractor [as obtained in **7.2.2**(c)].

f) Calculate the power in accordance with the procedures as given in **7.2.1**(d).

g) Repeat the above a minimum of 5 times to arrive at average power requirement. Data should be recorded as in Appendix C.

7.2.3 Repeat **7.2.1** and **7.2.2** for all the tests (*see* **7.0**).

7.3 Field Efficiency

7.3.1 *Effective Field Capacity or Output* — The plough should be operated for continuous field work for at least 4 hours and the area covered during the period shall be measured in hectare. Calculate the average of output per hour.

7.3.1.1 If facilities exist, plough may be operated for at least three days and an average of output should be obtained by dividing the area covered with the number of hours for which plough has been used.

7.3.2 *Theoretical Field Capacity* — On the basis of the width of furrow (*see* **7.1.2.1**) and speed [*see* **7.2.1**(c) and **7.2.2**(c)], theoretical field capacity should be calculated by following formula:

$$\text{Theoretical field capacity in hectare/h} = \frac{\text{Width in cm} \times \text{Speed in m/sec} \times 36}{10\,000}$$

7.3.3 *Field Efficiency* — This should be calculated as follows:

$$\text{Field efficiency, percent} = \frac{100 \times \text{Effective field capacity}}{\text{Theoretical field capacity}}$$

Record the data as in Appendix C.

7.4 Soil Inversion — It should be measured by the weed count method described as follows.

7.4.1 A square ring (30 × 30 cm) should be placed at random in the field before starting the test. The number of weeds and stubbles enclosed within this ring should be counted. Take at least five observations at different places in test plot. Record the observations as in Appendix C.

7.4.2 Repeat the above process after ploughing the field and record the data as in Appendix C.

7.4.3 Calculate the soil inversion as follows:

$$\text{Soil inversion, percent} = \frac{100\ (\text{No. of weeds before test} - \text{No. of weeds after test})}{\text{Number of weeds before test}}$$

7.5 Soil Pulverization — Measure the depth of penetration by a penetrometer [*see* **4.1** of IS : 2720 (Part V)-1970*] as follows.

7.5.1 The penetrometer should be held vertically at a place selected at random in the field after ploughing and a hammer should be dropped on it from the height of one metre. The depth of penetrometer should be recorded after every two drops. The time gap between these two strokes should be as short as possible. The angle of the metallic cone and weight of the hammer should be stated in the test report.

*Methods of test for soils : Part V Determination of liquid and plastic limits.

7.5.2 Repeat the above at least at five places in the field and record the data as in Appendix C.

7.6 Performance Index — Calculate performance index as follows:

$$PI = \frac{d \times A \times I \times P}{D}$$

where

PI = performance index,

d = depth in cm,

A = effective field capacity in hectare per day of 8 h,

I = soil inversion expressed as percent,

P = pulverization in terms of penetrometer reading in cm, and

D = draft in kgf per cm^2.

The above formula should be applied in judging the overall performance of a plough and a comparative study may be made if there are number of ploughs to be tested in same soil condition. Record the data as in Appendix C.

7.7 Ease of Operation — Assess the following:

a) Whether the plough is balanced during the operation?

b) Whether the plough scours properly?

c) Is there any marked clogging of soil in the throat?

Record the observations as in Appendix C.

7.8 Soundness of Construction — The deformation and breakage of parts should be checked during the test for its soundness and observations should be recorded as in Appendix C.

7.9 Wear in Share — The loss in weight of the share after completing each test and after entire test shall be recorded as in Appendix C.

8. SUMMARY REPORT

8.1 For reducing the data to a readily usable form and for preparing a meaningful report, compile a ' Summary Report ' as given in Appendix D.

APPENDIX A

(*Clauses* 4.2 *and* 5.1)

DATA SHEET — SPECIFICATION SHEET

FOR APPLICANT/FOR TESTING STATION

1. Name and Address of Applicant
2. Trade Name and Model of Plough
3. Sample Number
4. Type of Sample
   a) Prototype
   b) Production model
5. Type of Plough
   a) One way
   b) Two way (reversible)
6. Number of Plough Bottom
7. Source of Power
   a) Animal, and
   b) Tractor
      1) Make and model
      2) hp range
8. Type of Share
   a) Slip
   b) Slipnose
   c) Shin
   d) Bar
   e) Special
9. Type of Mouldboard
   a) Sod
   b) Stubble

c) General purpose

d) Special

10. Handle

a) Number:
   1) Single
   2) Double

b) Material:
   1) Wooden
   2) Steel

c) Grip height from ground

11. Landside

a) It is a part of frog or separate

b) Heel is part of landside or detachable

c) Size

12. Standard

a) Type

b) Location

13. Beam

a) Wooden
   1) Long
   2) Short
   3) Size (cross section and length)

b) Steel
   1) Straight
   2) Curved
   3) Size (cross section and length)

14. Clevis

a) Vertical

b) Horizontal

15. Type of Hitching
    a) Mounted
    b) Trailed
    c) Semi-mounted
16. Hitching Pin
    a) Pin dia:
        1) Top link
        2) Lower link
    b) Pin length
17. Cross Shaft
    a) Diameter
    b) Range of variation
18. Attachments Provided
    a) Gauge wheel
    b) Coulter
    c) Jointer
    d) Braces
    e) Weed hook
    f) Rear furrow wheel
    g) Front furrow wheel
19. Size of Plough
20. Clearances
    a) Vertical
    b) Horizontal
21. Adjustments Provided for
    a) Depth
    b) Width
    c) Any other

22. Wing Bearing
23. Throat Clearance
24. Angle of Penetration
25. Cleavage Angle
26. Size of Different Bolts and Nuts
27. Total Weight

Signature of Applicant Test Engineer

APPENDIX B

(*Clause* 5.2)

DATA SHEET FOR LABORATORY TESTS

1. Date of Test
2. Material of Construction and Hardness

Sl No.	Name of Part	Material Used	Hardness	Depth of Hardness
(1)	(2)	(3)	(4)	(5)
1.	Share			
2.	Mouldboard			
3.	Landside			
4.	Frog			
5.	Any other parts			

3. Weight of Share
4. How Different Parts are Attached
5. Interchangeability of Parts
6. Facility for Replacing Wornout Parts

7. Simplicity of Construction

8. Alignment of Plough

   a) Distance between two consecutive share points

   b) Distance between two consecutive heels of landside

   c) All share points are in same horizontal plane and lie in one straight line

   d) Beam of all plough bottoms are in same horizontal plane

   e) All bearing points of each plough bottom are in one horizontal plane

   f) Landside of one plough bottom and wing of share of next bottom are lying in one straight line parallel to direction of motion

Test Engineer

APPENDIX C

(*Clauses* 6.2 *and* 7.1 *to* 7.9)

DATA SHEET FOR FIELD TEST

1. Date of Test

2. Site of Test

3. Field Conditions

   a) Type of soil

   b) Last crop grown

   c) Date of last crop harvested

   d) Dates and details of preceding tillage treatments

   e) Soil moisture percentage

   f) Bulk density

   g) Topography of field

4. Size of Test Plot
   a) Length
   b) Width
5. Cone Angle of Penetrometer
6. Weight of Hammer
7. Total Time of Test
8. Test Observations

Sl No.	Observations	Measurements No.				
		1	2	3	4	5.....10 Average
i)	Depth of furrow (cm)					
ii)	Width of furrow (cm)					
iii)	Time taken to traverse 30 m length in seconds					
iv)	Draft in (kgf)					
v)	Output per day of 8 hours (hectare)					
vi)	Weed count before ploughing					
vii)	Weed count after ploughing					
viii)	Penetrometer readings (cm)					
ix)	Weight of share before test (g)					
x)	Weight of share after test (g)					

9. Speed of Ploughing
10. Unit Draft (kgf/cm^2)
11. Horse Power Requirement
12. Theoretical Field Capacity

13. Field Efficiency
14. Soil Inversion, Percent
15. Pulverization
16. Performance Index
17. Wearing of Share (g) after Completing the Test
18. Scouring
19. Balance of Plough
20. Clogging of Throat
21. Uniformity of Furrow
22. Details of Deformations and Break-Down
23. Any Other Remarks

Test Engineer

APPENDIX D

(Clause 8.1)

SUMMARY REPORT

1. Trade Name and Model of Plough
2. Type of Sample — Prototype/Production Model
3. Name and Address of Applicant
4. Dates and Duration of Test
5. Type of Soil
6. Width of Furrow
7. Depth of Furrow
8. Output per Day of 8 Hours
9. Draft

10. Horse Power Requirement
11. Ease of Operation
12. Alignments
13. Workmanship and Rigidity
14. Interchangeability of Fast Wearing Components
15. Tools and Accessories, if any, Supplied by the Applicants
16. General Remarks

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